



ARSET

Applied Remote Sensing Training

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 @NASAARSET

Satellite Aerosol Validation

The Practical Use of Satellite Observations for Visibility and Air Quality Analysis

Monday, September 26, 2016

Atmospheric Optics: Aerosols, Visibility, and the Radiative Balance

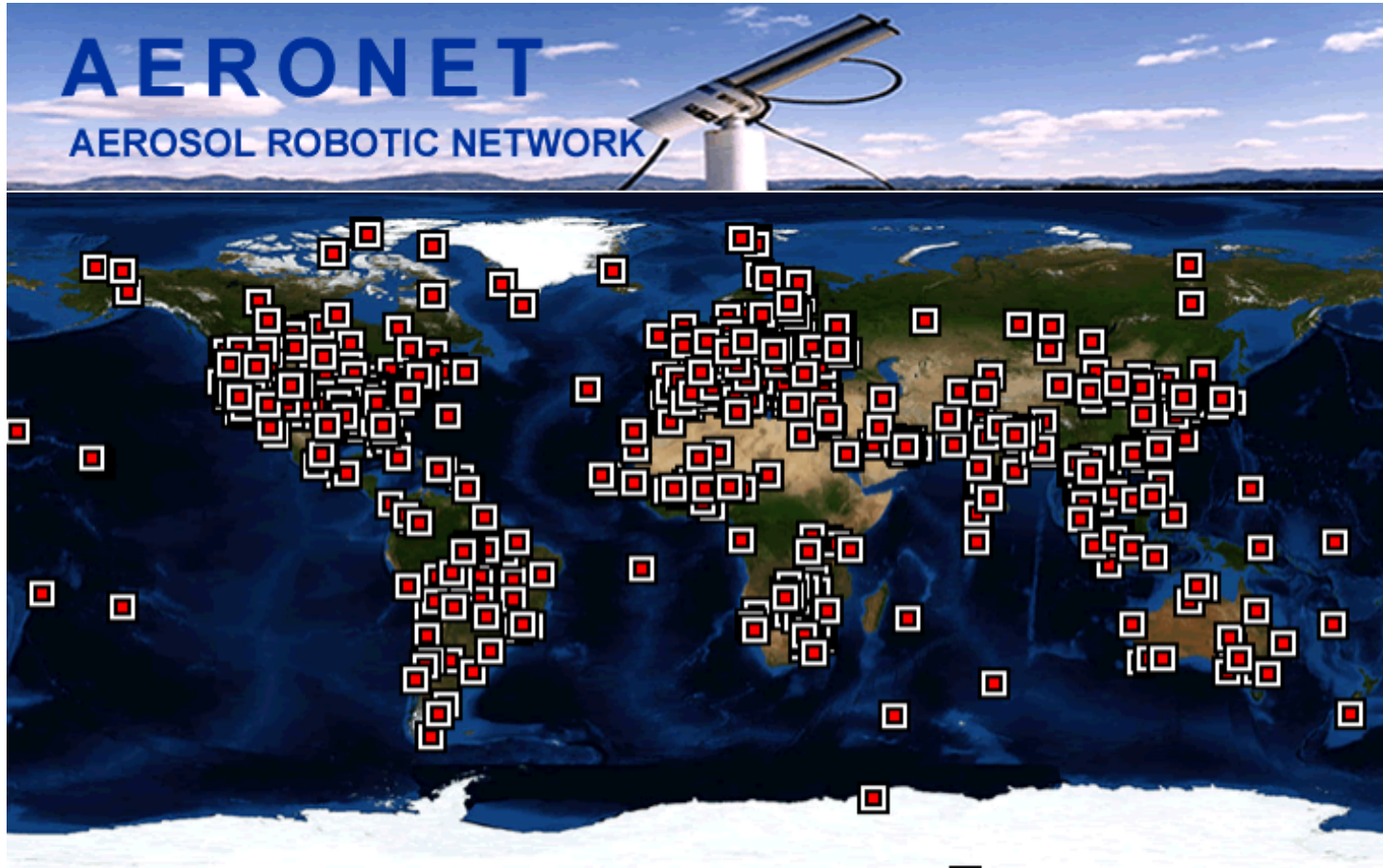
Jackson Hole, Wyoming, USA

Objectives

- To learn how to validate satellite derived aerosol optical depth
- To understand the uncertainties in MODIS aerosol product
- To access data and tools for validating satellite aerosol products

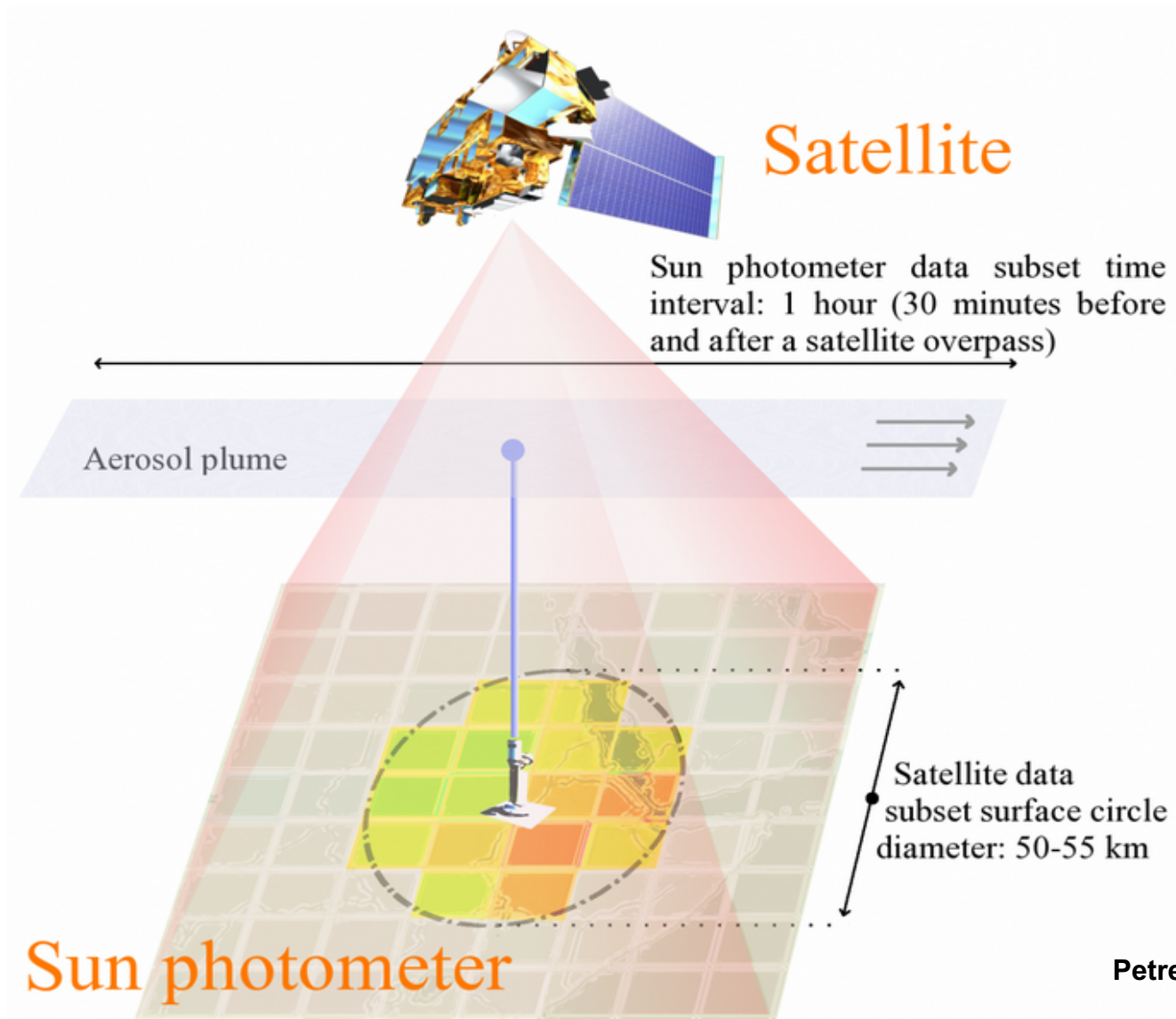
AERONET

<http://aeronet.gsfc.nasa.gov/>



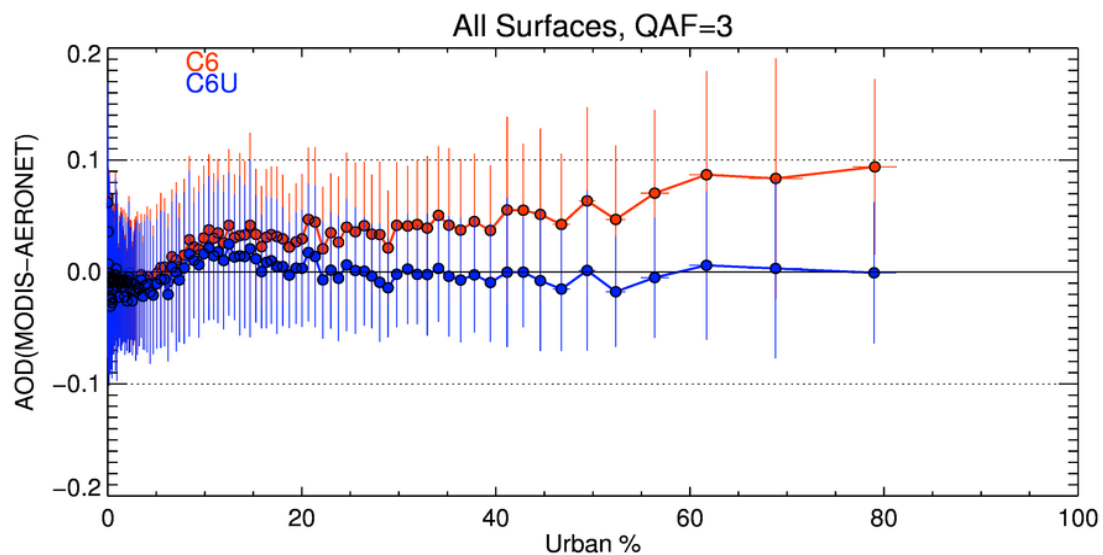
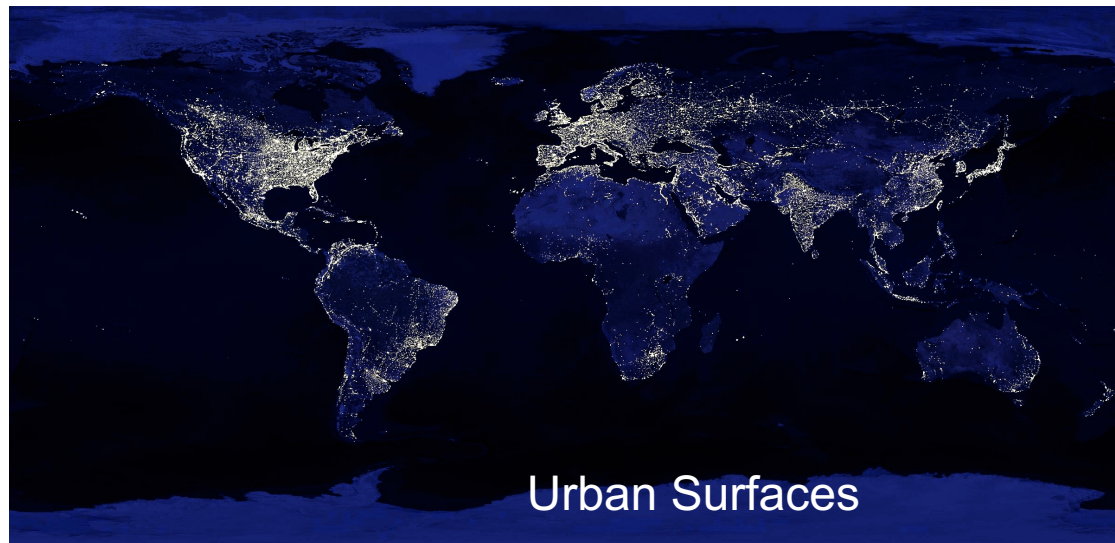
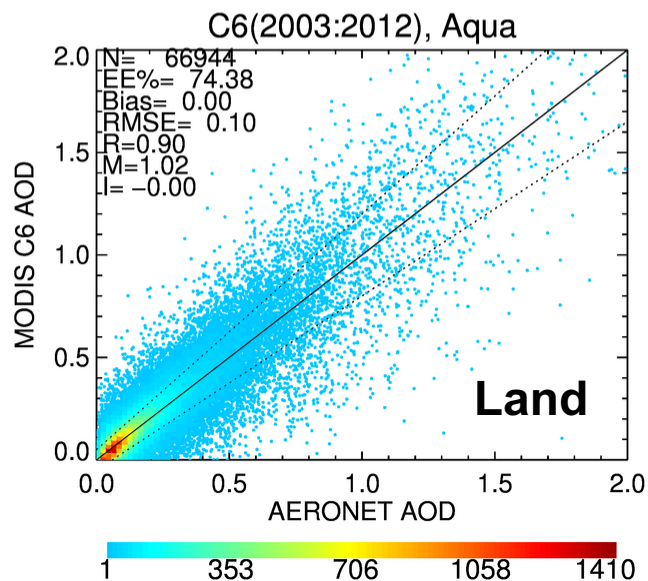
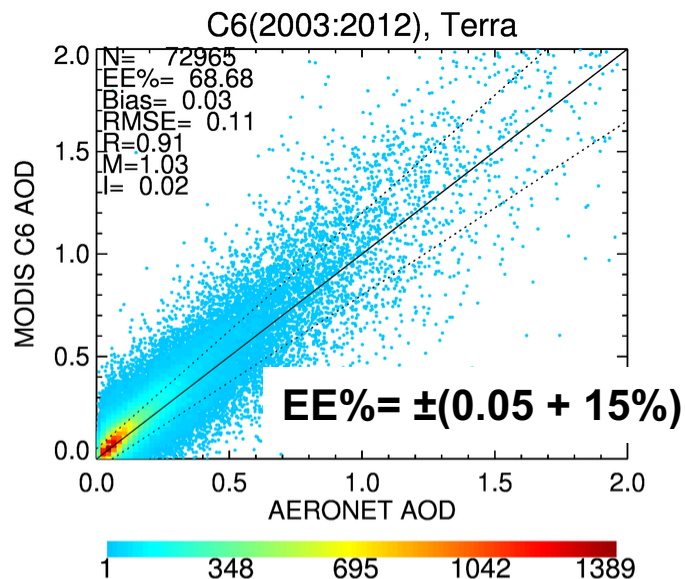
Serves as a validation tool for satellite air quality products

Spatial and Temporal Collocation



Petrenko et al., 2012


MODIS Dark Target AOD Validation



Source: Gupta et al., 2016

Dark Target

<http://darktarget.gsfc.nasa.gov/>



Dark Target

MODIS Aerosol Retrieval Algorithm

CLIMATE & RADIATION

Search

ALGORITHM

PRODUCTS

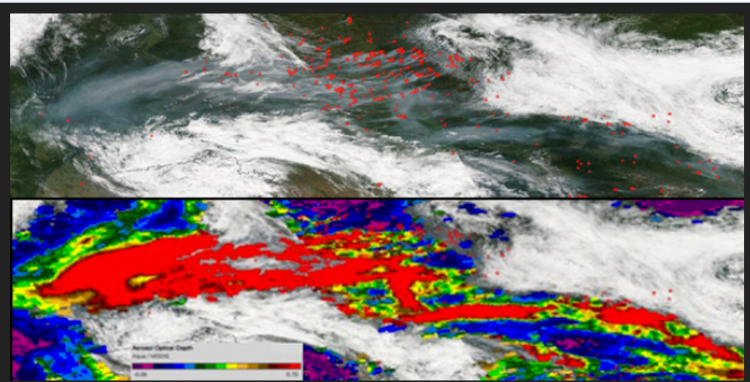
VALIDATION

PLATFORMS

REFERENCE

FAQ

LINKS



Fires and smoke in Russia captured by Aqua on June 29, 2012. Aqua true color image and fire detections in upper panel, dark target AOD 10 Km product in lower panel.

The effect of aerosols is one of the greatest sources of uncertainty in climate modeling. Aerosols vary in time in space and can lead to variations in cloud microphysics, which impact cloud radiative properties and climate. The Dark-Target (DT) aerosol retrieval algorithm is applied to multispectral satellite data, and derives aerosol properties including aerosol optical depth (AOD) over land and ocean, and spectral AOD and aerosol size parameters over ocean. Products of the DT retrieval are used to develop global and regional aerosol climatology, to study the interaction of aerosols with clouds, and for air quality assessments and forecasts.

There are two separate and distinct "Dark Target" (DT) algorithms. The first one is used for retrieving aerosol information over ocean (dark in visible and longer wavelengths) and the second one over vegetated/dark-soiled land (dark in the visible). In theory, these algorithms can be applied

MODIS Dark Target AOD Uncertainties

MODIS 10 Km Product

	Collection 5		Collection 6 (Interim Values)	
	Ocean	Land	Ocean	Land
Aqua	$\pm (0.03 + 5\% \text{ of } \tau)$	$\pm (0.05 + 15\% \text{ of } \tau)$	$(-0.02 - 10\% \text{ of } \tau)$ $(+0.04 + 10\% \text{ of } \tau)$	$\pm (0.05 + 15\% \text{ of } \tau)$
Terra	$\pm (0.03 + 5\% \text{ of } \tau)$	$\pm (0.05 + 15\% \text{ of } \tau)$	Data not yet available	Data not yet available

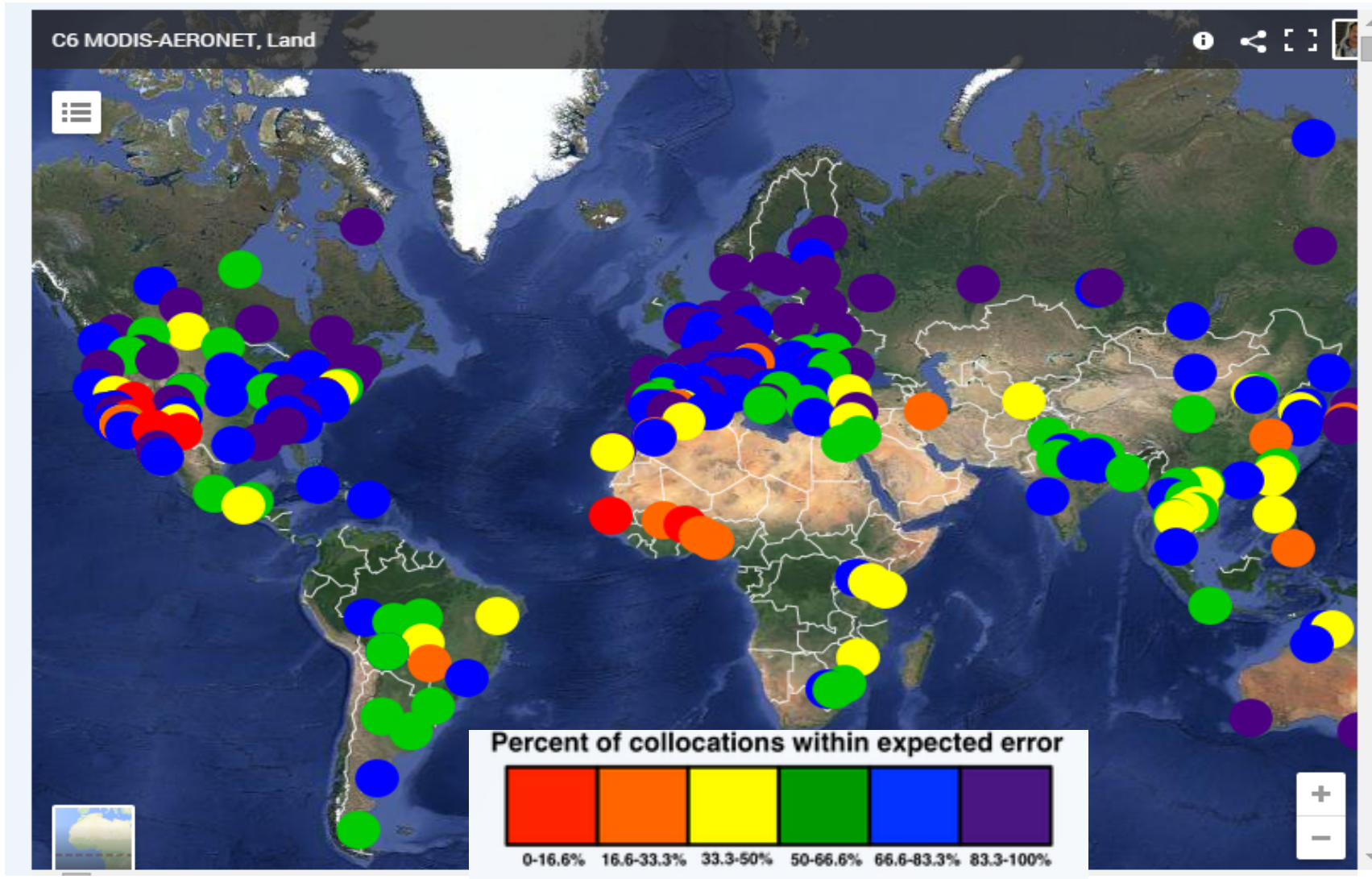
MODIS 3 km Product Uncertainty Values for Collection 6 (Interim Values)

	Ocean	Land
Aqua	$\pm (0.04 + 5\% \text{ of } \tau)$	$\pm (0.05 + 20\% \text{ of } \tau)$
Terra	Data not yet available	Data not yet available

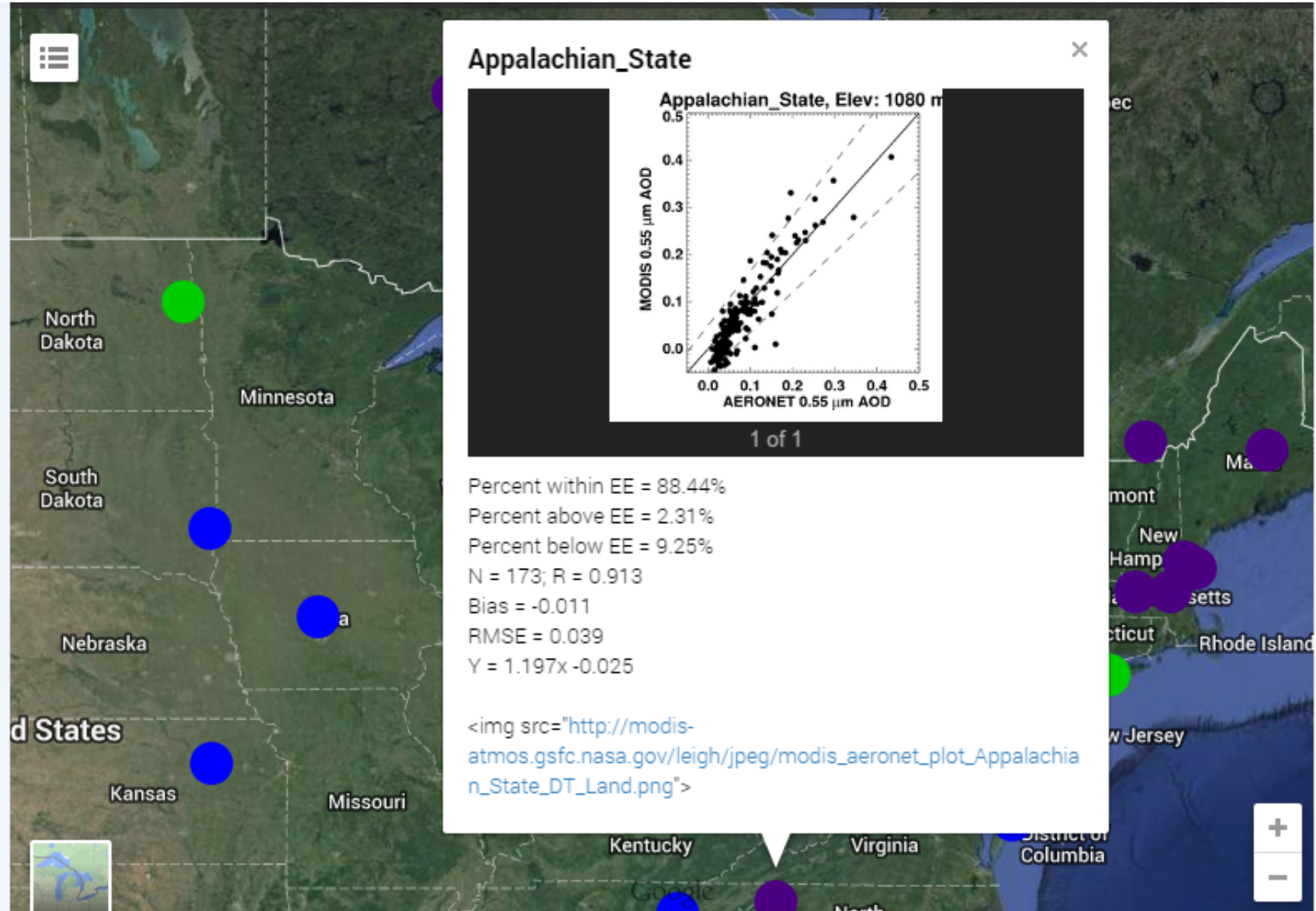
Source: darktarget.gsfc.nasa.gov

Validation Maps

<http://darktarget.gsfc.nasa.gov/>



Scatter Plot



Deep Blue Product

<http://deepblue.gsfc.nasa.gov>



Deep Blue

Multi-Sensor Aerosol Project

Climate & Radiation Laboratory

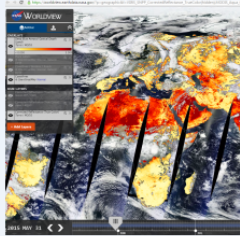
Home Aerosols Science Data Links Documentation FAQ Contact Us

Welcome to the Deep Blue aerosol project webpage

Deep Blue uses measurements made by satellite instruments orbiting the Earth to determine the amount of aerosols in the atmosphere, and the properties of those aerosols. 'Aerosols' is a catch-all term covering particles suspended in the atmosphere, including but not limited to desert dust, smoke, volcanic ash, industrial smog, and sea spray. Improving our understanding of aerosols is important for reasons related to Earth's climate, human health, and ecology, as well as many others.

This website is designed to act as a single portal to provide information to both new and experienced data users about our data sets, as well as give an overview of what we do and why we do it to non-specialists. Please use the links across the top of the page to navigate, and feel free to contact us with any questions.

Recent news relating to Deep Blue, such as new data versions or publications, are listed below. You can also [subscribe to our RSS feed](#) for updates.



MODIS Deep Blue Collection 6 data now available in NASA Worldview

MODIS Terra true color overlaid with Deep Blue aerosol optical depth, showing data from May 31 2016.

We are pleased to announce that select MODIS Collection 6 Atmospheres data products, including Deep Blue aerosol data, are now available on the [NASA Worldview satellite imagery browsing tool](#). At present, data from 2007-2015 are currently available. Earlier years, as well as 2016 data (and near-real-time availability), are being added.

Key features of Worldview include:

[Read more](#)

Aerosols - above - clouds article featured as an EOS research spotlight

The American Geophysical Union ([AGU](#)) have selected our [recent article about monitoring aerosols above clouds](#) for a Research Spotlight. The

MAPSS

Multi-sensor Aerosol Products Sampling System

- Giovanni instances
- Used to evaluate the quality of satellite retrievals
- MAPSS allows you to compare AERONET data with coincident satellite data
- Quick and effective way to evaluate the quality of the satellite retrieval at particular locations for a range of dates or seasons
- Data from MODIS & MISR
 - Satellite-AERONET Inter-Comparison: <http://giovanni.gsfc.nasa.gov/mapss/>
 - Multi-Sensor Statistics: http://giovanni.gsfc.nasa.gov/mapss_explorer/

MAPSS: Multi-sensor Aerosol Products Sampling System

This user interface is used to obtain selected parameter statistics from the [MAPSS](#) database for a chosen location and time period. Time Series Plot is the available service. Plot output is rendered as a graph and is also available in ASCII format.

Data Selection

Results

NEW [Try out the MAPSS Statistical Explorer](#)

Plot Data

Reset

Clear

Send Us Feedback!

Help

Select Station

Click 'Browse' button or type in comma separated names of s

Select Plot

Satellite Colocated with AERONET

☒ [Time Series](#)

☐ [Scatter Plot](#)

Select Measurements

Click each list below (beginning with the left-most list) to show the set of fully qualified measurements. Set

☒ Basic ☐ Advanced

Product

AERONET aerosols L2, ver. 2
AERONET deconvolution L2, ver. 41
AERONET inversions L1.5, ver. 2
AERONET inversions L2, ver. 2
CALIPSO column and layer aerosols

[More...](#)

Selected Measurements

Parameter

Layer

Measurement

Current Result: [MAPSS TIME SERIES \(6C2294D97C9F\)](#)

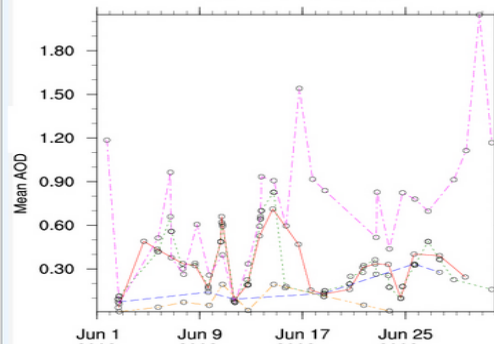
[View Plots](#)

[View Lineage](#)

[Download Data](#)

[Problem? Send a report...](#)

MAPSS Time Series

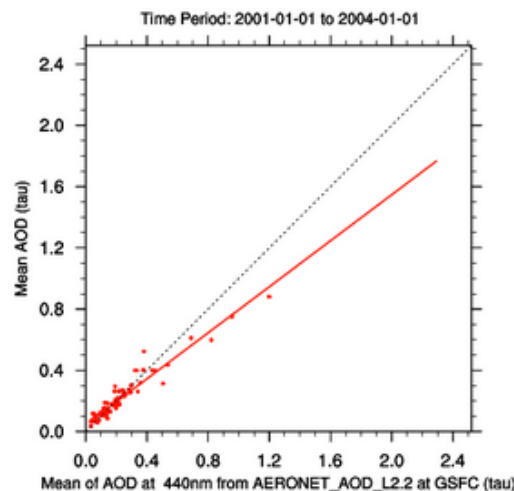


—○— Mean AOD: Mean of AOD - polarized from P3L2TLGC.K at GSFC
—○— Mean AOD: Mean of Best AOD at 500nm from OMAERUV.003 at GSFC
—○— Mean AOD: Mean of AOD at 500nm - total from AERONET_SDA_L2.41 at GSFC
—○— Mean AOD: Mean of Best estimate of AOD at 558nm from MIL2ASAE.0022 at GSFC
—○— Mean AOD: Mean of AOD at 550nm - land and ocean from MOD04_L2.005 at GSFC

Result 3 - AEROSTAT_SCATTER_PLOT:

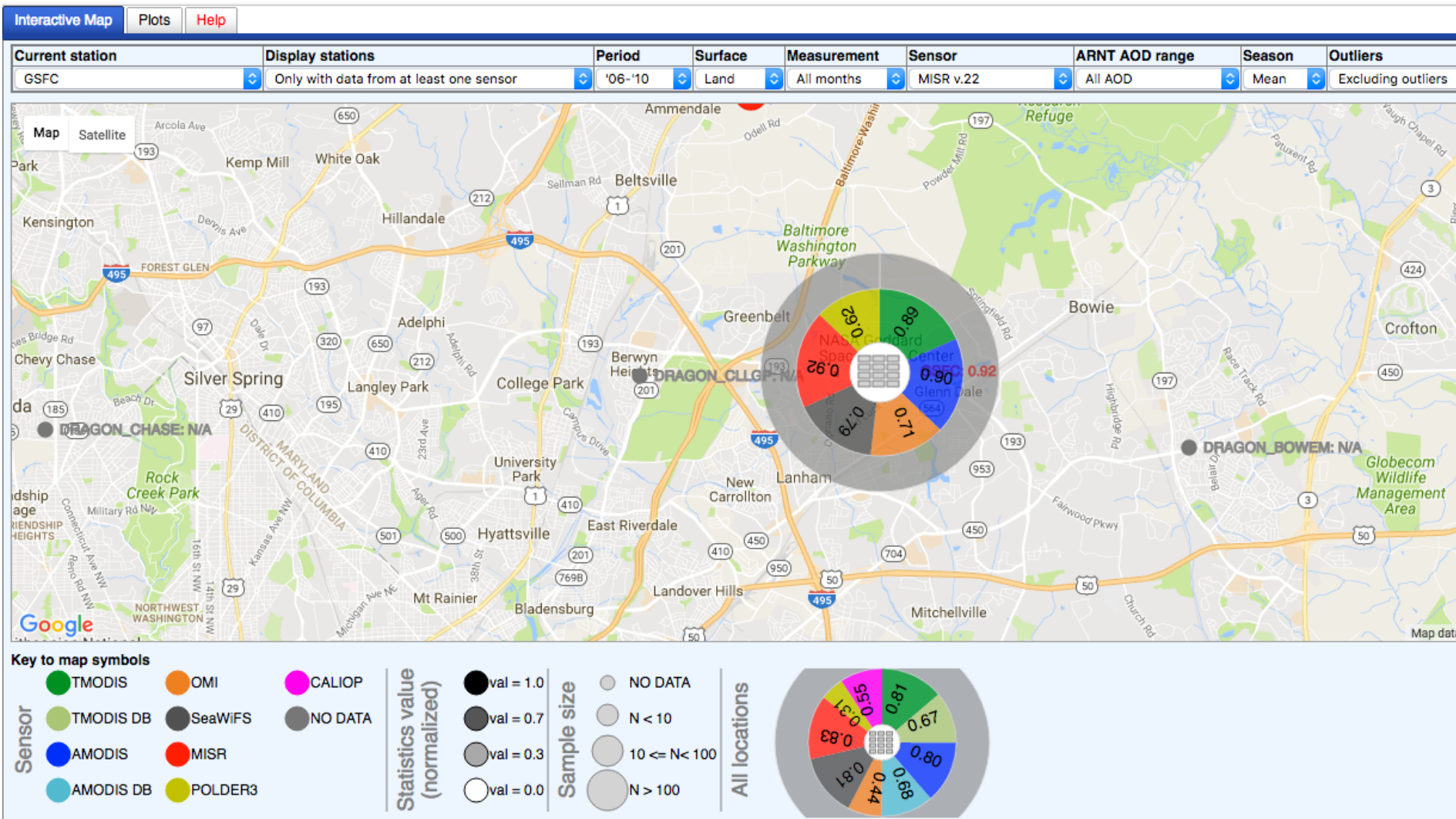
[View Criteria](#)

[Problem? Send a report...](#)

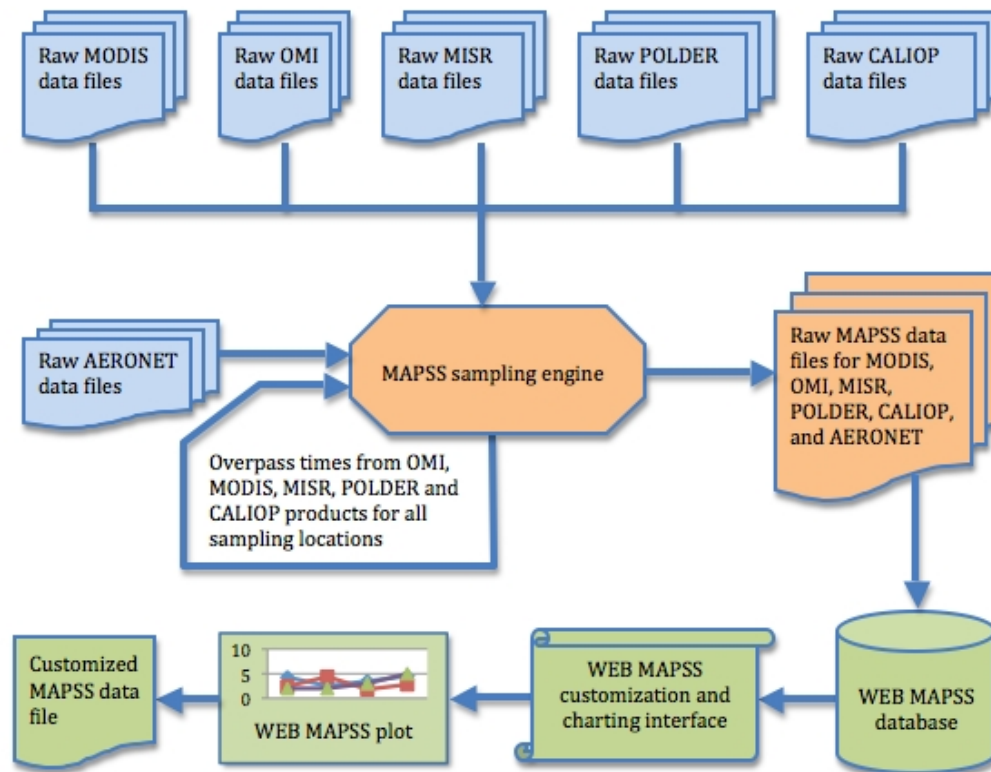


MAPSS Statistical Explorer

http://giovanni.gsfc.nasa.gov/mapss_explorer/



MAPSS – Further Reading



Petrenko, M., and C. M. Ichoku. 2013. "Coherent uncertainty analysis of aerosol measurements from multiple satellite sensors." *Atmos. Chem. Phys.*, 13 (14): 6777-6805 [10.5194/acp-13-6777-2013] [Journal Article/Letter]

Petrenko, M., C. M. Ichoku, and G. Leptoukh. 2012. "Multi-sensor Aerosol Products Sampling System (MAPSS)." *Atmospheric Measurement Techniques*, 5 (5): 913-926 [10.5194/amt-5-913-2012] [Journal Article/Letter]

Published Validation Results

Levy, R. C., Mattoo, S., Munchak, L. A., Remer, L. A., Sayer, A. M., Patadia, F., & Hsu, N. C.. (2013). The Collection 6 MODIS aerosol products over land and ocean. *Atmospheric Measurement Techniques*, 6, 2989–3034. doi:10.5194/amt-6-2989-2013

Remer, L. A., Mattoo, S., Levy, R. C., & Munchak, L. A.. (2013). MODIS 3 km aerosol product: algorithm and global perspective. *Atmospheric Measurement Techniques*, 6, 1829–1844. doi:10.5194/amt-6-1829-2013

Sayer, A. M., N.-Y. C. Hsu, C. Bettenhausen, and M.-J. Jeong. 2013. "Validation and uncertainty estimates for MODIS Collection 6 “Deep Blue” aerosol data." *J. Geophys. Res. Atmos.*, 118 (14): 7864-7872 [10.1002/jgrd.50600]

Sayer, A. M., L. A. Munchak, N.-Y. C. Hsu, et al. 2014. "MODIS Collection 6 aerosol products: Comparison between Aqua's e-Deep Blue, Dark Target, and “merged” data sets, and usage recommendations." *J. Geophys. Res.-Atmos*, 119 (24): 13,965-13,989 [10.1002.2014JD022453]